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GR1232-A, -AP Tuned Amplifier and Null Detector

Form 1232-0100-00

Instruction Manual

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GR1232-A, -AP Tuned Amplifier and Null Detector

and GR-1240-A, -AP Bridge Oscillator-Detector

Form 1232-0100-00

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Concord, Massachusetts, U.S.A. 01742
December, 1988

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Refer to para 4.3 for battery installation.

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WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable GenRad specifications. If within one year after original shipment it is found not to meet this standard, it will be repaired or, at the option of GenRad, replaced at no charge when returned to a GenRad service facility. Changes in the product not approved by GenRad shall void this warranty. GenRad shall not be liable for any indirect, special, or consequential damages, even if notice has been given of the possibility of such damages.

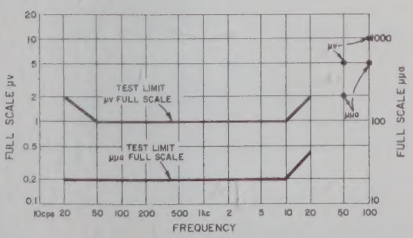
THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Specifications

TYPE 1232-A TUNED AMPLIFIER AND NULL DETECTOR

Frequency Response: TUNABLE FILTERS: 20 Hz to 20 kHz in 3 ranges; between 2% and 6% bandwidth to 15 kHz; 2nd harmonic at least 34 dB down from peak, 3rd at least 40 dB down; rejection filter on two highest ranges reduces 60-Hz level to at least 60 dB below peak response (50-Hz level is down >50 dB). Dial accuracy is ±3%. FIXED-TUNED FILTERS: 50 kHz, 2nd harmonic is 44 dB down; 100 kHz . . . 53 dB down. FLAT RESPONSE: ±3 dB from 20 Hz to 100 kHz.
Sensitivity: See plot. Typically better than 0.1 μV over most of the frequency range.
Noise Level: REFERRED TO INPUT: See plot. Noise figure at 1 kHz is less than 2 dB at an optimum source impedance of 27 kΩ. REFERRED TO OUTPUT: Less than 5 mV on FLAT filter-frequency position, min gain setting, and −20-dB switch position; less than 50 mV in MAX SENS position.
Input: IMPEDANCE: Approx 50 kΩ at max gain; varies inversely with gain to 1 MΩ at min gain. MAX SAFE VOLTAGE: 200 V ac or 400 V dc.
Output: VOLTAGE GAIN: Approx 120 dB on the tunable ranges: 100 dB, flat range; 106 dB at 50 kHz; 100 dB at 100-kHz position. LEVEL: 1 V into 10 kΩ when meter indication is full scale. INTERNAL IMPEDANCE: 3 kΩ. METER LINEARITY: dB differences are accurate to ±5% ±0.1 division for inputs of less than 0.3 V. COMPRESSION (meter switch to LOG): Reduces fullscale sensitivity by 40 dB. Does not affect bottom 20% of scale. ATTENUATION (meter switched to −20 dB): Linear response with 20-dB less gain than MAX SENS.
Distortion (filter switch in FLAT position): <5% (due to meter rectifiers).
Terminals: Input, GR874® coaxial connector; output, binding posts.
Available: 1232-P2 Preamplifier to maintain sensitivity of 1232-A at low frequencies when operating from a source impedance above 100 kΩ; rack-adaptor sets (see below) convert 1232 alone, or with companion instruments, to 19-in. rack-mount width.
Power: 12 V dc, from 9 mercury (M72) cells in series. Est battery life 1500 hours. Optionally, a rechargeable battery (non-mercury) can be supplied on special order.
Mechanical: Convertible bench cabinet. DIMENSIONS (wxhxd): Bench, 8x6x7.5 in. (203x152x190 mm). WEIGHT: 5.75 lb (2.6 kg) net, 8 lb (3.7 kg) shipping.

Description	Catalog Number
1232-A Tuned Amplifier and Null Detector	**1232-9701**
1232-AP Tuned Amplifier and Null Detector, with preamplifier	**1232-9829**
Rack-Adaptor Sets	
480-P308, for 1232-A alone	**0480-9838**
480-P316, for 1232-A with 1310 or 1311 oscillator or similar 8-in. wide instrument with convertible-bench cabinet	**0480-9836**
480-P317, for 1232-AP (with preamp) and companion 8-in. instrument	**0480-9837**
Replacement Battery, 9 req'd	**8410-1372**



Minimum input for full-scale meter deflection as a function of frequency.

TYPE 1232-P2 PREAMPLIFIER

(Accessory supplied with Type 1232-AP and Type 1240-AP only)

Voltage Gain: Approx 0.7.
Noise (referred to input): Open-circuit equivalent 0.1 pA; short-circuit equivalent, 0.3 μV (when used with Type 1232-A tuned to 100 Hz).
Impedances: INPUT: >100 mΩ in parallel with 70 pF. OPTIMUM SOURCE: 3 MΩ. OUTPUT: 10 kΩ.
Connectors: GR874® on cables, input and output.
Power: 12 V, 200 μA, supplied by 1232-A.
Mechanical: Special cabinet. DIMENSIONS (wxhxd): 0.75x6x7.5 in. (19x152x190 mm). WEIGHT: 0.94 lb (0.43 kg) net, 4 lb (1.9 kg) shipping.

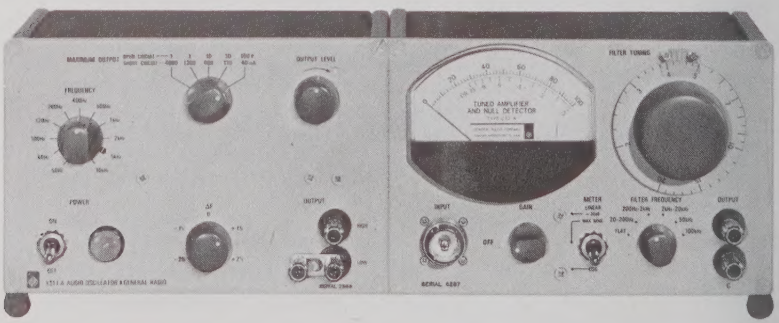
Description	Catalog Number
1232-P2 Preamplifier	**1232-9602**

TYPE 1240-A, -AP BRIDGE OSCILLATOR-DETECTORS

The Type 1240-A Bridge Oscillator-Detector is a rigid assembly of a Type 1311 Audio Oscillator and a Type 1232 Tuned Amplifier and Null Detector. The Type 1240-AP includes the Type 1232-P2 Preamplifier in addition to the above instruments. These compact assemblies are convenient for use with audio-frequency bridges and other null-balance devices.

The units are secured with an Adaptor Plate Set (P/N 0480-9836 for 1240-A, 0480-9837 for 1240-AP) and bolted together near the rear of the instruments. The assembly fits a standard 19-inch relay rack. For bench use, the two wings of the relay-rack adaptor set can be removed and the four rubber feet can be installed in the corners of the oscillator-detector assembly.

Operating instructions for the Type 1232-A or -AP Tuned Amplifier and Null Detector are given in this book. A separate instruction book is supplied for the Type 1311 Audio Oscillator.



GR 1240-A Bridge-Oscillator-Detector.

Introduction–Section 1

Figure 1. Type 1232-A Tuned Amplifier and Null Detector.

1.1 PURPOSE

The Type 1232-A Tuned Amplifier and Null Detector (Figure 1) is a sensitive, low-noise amplifier continuously tunable from 20 Hz to 20 kHz, with additional fixed-tuned frequencies of 50 kHz and 100 kHz. Intended primarily as a bridge detector, the Type 1232-A can also be used as a detector of high-frequency modulated signals (with a crystal demodulator), a wave analyzer at audio frequencies, and a preamplifier for transducers.

The Type 1232-P2 Preamplifier can be added to improve the signal-to-noise ratio and consequently the effective sensitivity of the Type 1232-A when the latter is to be driven by very high (greater than 100 kΩ) impedance sources.

1.2 DESCRIPTION

The Type 1232-A consists of a low-noise preamplifier, a frequency-selective stage (feedback amplifier and null network), an amplifier-compressor stage, and a meter-rectifier circuit (see block diagram, Figure 2). The total gain of the amplifier is about 120 dB. Full-scale meter sensitivity is 1 microvolt or better over most of the frequency range.

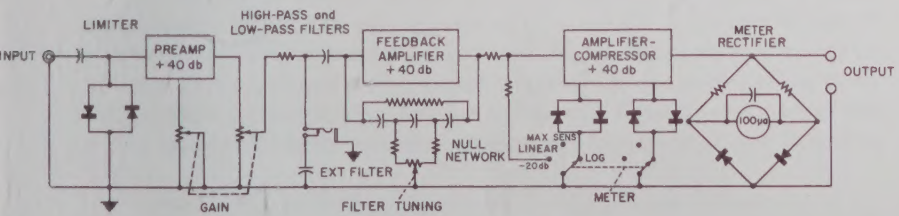


Figure 2. Functional diagram of the null detector.

With the Type 1632 Inductance Bridge, this null detector permits inductance balances to a resolution of 1 part in 10^6. Comparable precision for capacitance balance can be obtained with the Type 1615 and 716 Capacitance Bridges.

The amplifier is powered by 12 Vdc, supplied by nine mercury batteries in series. The output is 1 V into 10,000 ohms.

Front mountings are extendible to tilt instrument face.

The Type 1232-P2 Preamplifier is a detachable accessory that consists of a low-noise field-effect transistor used in common-source configuration. Power for the preamp is provided by the B + supply of the Type 1232-A.

1.3 CONTROLS AND CONNECTORS OF THE TYPES 1232 AND 1232-P2.

TABLE 1

	Name	*Type*	*Function*
Type 1232	FILTER TUNING	Continuous rotary control	Tunes filter within selected tuning range.
	FILTER FREQUENCY	6-position rotary switch	Selects desired frequency characteristic; tuning-frequency range of 20-200 Hz, 200 Hz-2 kHz, or 2-20 kHz; flat, 50-kHz or 100-kHz response.
	GAIN	Rotary control	Turns instrument on or off and controls gain.
	METER	3-position toggle switch	Selects full-gain linear, -20-dB linear, or logarithmic response.
	INPUT	GR874 Locking Coaxial Connector	Input terminals.
	OUTPUT	Pair of Type 938 Binding Posts	Output terminals.
	EXTERNAL FILTER	Phone jack	Connection for external filter.
Type 1232-P2	HIGH Z, LOW Z	Toggle switch	Determines whether Preamplifier is included in input to Type 1232 (HIGH Z) or shunted (LOW Z).
	INPUT	GR874 Connector and Cable Assembly	Input terminals.
	OUTPUT	GR874 Connector and Cable Assembly	Output terminals (to be applied to INPUT of Type 1232).

1.4 USE OF EXTERNAL FILTERS.

Filters can be connected at the EXTERNAL FILTER jack. When a telephone plug is inserted in this jack, the built-in shunt filter is disconnected. The external filter may be either a series-tuned circuit to trap out an undesired frequency or an antiresonant parallel-tuned circuit to improve the selectivity at the desired frequency. For the purpose of calculating the Q of the external filter, the source impedance is about 700 ohms. Since the external filter is plugged into the circuit at a point beyond the 60-Hz rejection filter and where there is 80-dB gain to the meter circuit, it is important that the external filter be shielded and preferably that it use a toroidal inductor for minimum sensitivity to hum pickup.

Principles of Operation—Section 2

2.1 PREAMPLIFIER OF THE TYPE 1232-A.

The preamplifier stage of the Type 1232-A Tuned Amplifier and Null Detector is designed to minimize noise from both low-impedance sources, such as inductance bridges at low frequencies, and high-impedance sources, such as capacitance bridges at low frequencies. A transistor with a noise figure of 3 to 5 dB at an optimum source impedance of 50 kilohms is used. By use of negative feedback, the input impedance of the preamplifier is also made 50 kilohms, and the noise level indicated on the output meter is relatively constant and independent of source impedance.

The input transistor is protected from possible damage due to large overloads by a limiter consisting of a series capacitor and two shunt silicon rectifier diodes. This circuit effectively prevents signals greater than 1 volt, peak-to-peak, from reaching the input transistor and does not contribute noise or distortion to low-level signals.

Maximum gain of the preamplifier is about 40 dB, which is adequate to swamp the noise of succeeding stages. After preamplification, the signal passes through a set of series and shunt filters, which are designed to reject frequencies above and below the selected tuning range. Typical filter characteristics are shown in Figure 3. On all switch positions except FLAT and 20 – 200 Hz, another rejection filter reduces the response at 60 Hz to greater than 60 dB below peak response.

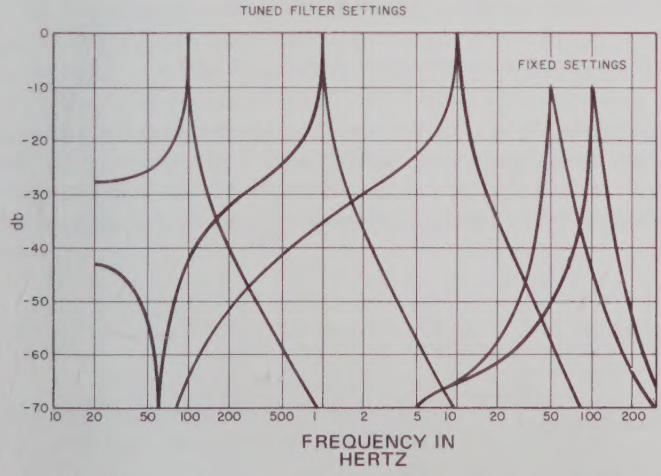


Figure 3. Typical filter characteristics of the Type 1232-A.

2.2 FREQUENCY-SELECTIVE AMPLIFIER.

This amplifier consists of three stages with negative feedback through a null network, which has its null at the desired operating frequency. Since there is negative feedback at all frequencies but the desired one, the over-all response peaks at this frequency and is roughly equivalent to that of a tuned circuit with a Q of about 20 (5% bandwidth). The unique feature of this null network is its one-potentiometer tuning. Many null networks require three variable elements, either ganged capacitors or ganged potentiometers. This leads to many problems in alignment and tracking the three elements to maintain a good null. The Hall null network has a perfect null in theory for any position of the tuning potentiometer, and it is possible to cover a 10:1 tuning range with a 40-dB exponential potentiometer. Tuning capacitors are switched to change ranges, maintaining the impedance level of the null network approximately constant for the three tuning ranges.

Since the 50-kHz and 100-kHz null networks need not be tunable, conventional twin-T null networks are used.

On the FLAT position of the range switch, all filters are switched out and the frequency response is flat to within ±3 dB from 20 Hz to 100 kHz. The overall gain of the amplifier is reduced by 26 dB to keep the noise level on the output meter equal to about 10 percent of full scale at maximum gain.

2.3 NULL NETWORK.

The Type 1232-A Tuned Amplifier and Null Detector uses an RC null network with only one variable component to adjust the frequency of the null. This avoids the use of ganged variable components, which must track closely to maintain stability when used in highly selective feedback amplifiers. The network (Figure 4), consisting of three-terminal RC circuits, gives a complete null without being balanced against a voltage divider, and permits frequency adjustment with a single potentiometer. The tuning law for this circuit is

$$\omega_0 = \frac{1}{RC\sqrt{\alpha(1-\alpha)\,(1+2k)}}$$

In order to span a 10-to-1 logarithmic frequency range, the potentiometer must have an exponential characteristic of over 100 to 1.

The selectivity of the transfer admittance, $\frac{I_o}{E_{in}}$ (or y_{21}) is quite constant

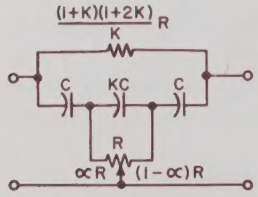


Figure 4. Null circuit of the Type 1232-A Tuned Amplifier and Null Detector.

as the null frequency is changed. In order to use this characteristic, the network must be driven by and loaded by low impedances. Therefore, it is used in a feedback circuit with an amplifier having low input and output impedances and a transfer resistance $\frac{E_o}{I_{in}}$ (or a real z_{21}) that is chosen to give the desired selectivity. This combination provides a second-harmonic rejection of 34 dB over each 10-to-1 frequency range.

2.4 AMPLIFIER-COMPRESSOR.

With the METER switch set to either linear position, the amplifier-compressor functions as a linear amplifier, driving the meter rectifier circuit and supplying the output terminals with about 1.4 V for full-scale deflection of the meter. The MAX SENS position provides full gain for very low-level applications. When maximum sensitivity is not required, use the LINEAR – 20 dB position for a less noisy output. With this switch setting, the noise generated in the input and selective amplifier stages is attenuated. The dc supplied to the last transistor is sufficient to drive the output meter to full scale, but very little more, so that it is impossible to damage the meter by overdriving the amplifier.

For null detector use, the METER switch is thrown to LOG, effectively compressing the upper part of the meter scale. Two pairs of silicon diodes are switched in shunt with the collector resistors of two transistors to provide a nonlinear collector impedance. Owing to the voltage offset of the silicon diodes, the bottom 20 percent of the meter scale is virtually unaffected. A signal level corresponding to 100 percent deflection for linear response will drop to 50 percent for logarithmic response. An increase of 20 dB increases the reading to 80 percent, and another 20 dB raises the reading to 100 percent.

2.5 METER CIRCUIT.

The meter circuit uses a full-wave rectifier in order to double the ripple frequency that passes through the meter and thus to prevent the needle from vibrating visibly at 20 Hz. Resistors are used in place of two of the rectifiers in the conventional full-wave bridge in order to linearize the relation between meter indication and signal level, and to minimize distortion. No dc amplification was incorporated into the meter circuit, so that there is no need for a dc zero adjustment on the front panel and no possibility of dc zero instability. High-impedance, crystal-type earphones can be connected to the output terminals.

Operation – Section 3

3.1 USE AS AN AMPLIFIER OR PREAMPLIFIER.

To use the Type 1232-A or -AP Tuned Amplifier and Null Detector as an amplifier:

a. Connect the input signal to the INPUT connector of the Type 1232 or, if used, the Type 1232-P2. Adaptors for connectors other than Type 874 are available from General Radio. If the output impedance of the source of this signal is greater than 100 kΩ, set the switch on the Type 1232-P2, if used, to HIGH Z; otherwise set the switch to LOW Z.

NOTE

For connection to binding posts, use a Type 874-R34 Patch Cord. (Hum pickup is too great with a Type 874-Q2 Adaptor.)

b. Set the METER switch to LINEAR –20 dB (unless maximum sensitivity is required.)

c. Set the FILTER FREQUENCY switch for the desired characteristic: FLAT, 20-200 Hz, 200 Hz – 2 kHz, 2-20 kHz, 50 kHz, or 100 kHz.

d. With the GAIN control, turn the instrument on and adjust the gain to the desired level. The total range of the GAIN control is 120 dB, and attenuation in dB is roughly proportional to the rotation angle of the control knob.

e. The OUTPUT terminals may be connected to an oscilloscope or headphones. The red binding post is high, the black binding post is ground.

The high sensitivity of this instrument permits its use as a preamplifier for transducer outputs or oscilloscope input.

3.2 USE AS A NULL DETECTOR FOR BRIDGE BALANCING.

To use this instrument as a detector for bridge measurements;

a. Connect the INPUT terminals of the Type 1232-A or -AP to the DETECTOR terminals of the bridge as in paragraph 3.1, step a.

b. Set the METER switch to LOG.

c. Set the FILTER FREQUENCY and FILTER TUNING controls to the desired frequency.

d. With generator and unknown connected to the bridge, set the GAIN control of the Type 1232-A for approximately half-scale deflection of the output meter, and tune the FILTER TUNING control for maximum output.

The bridge balance can now be made in the conventional manner, by readjustment of the GAIN control as balance is approached.

3.3 USE IN AUDIO SPECTRUM ANALYSIS.

The tuned amplifier can be used as an audio-frequency wave analyzer with a sensitivity of 1 μV and a bandwidth of about 5 percent. For approximate measurements, the gain can be assumed to be constant with frequency. More accurate measurements can be obtained if the amplifier is first calibrated with a constant-amplitude, variable-frequency signal. The typical variation of peak response vs frequency is shown in Figure 5.

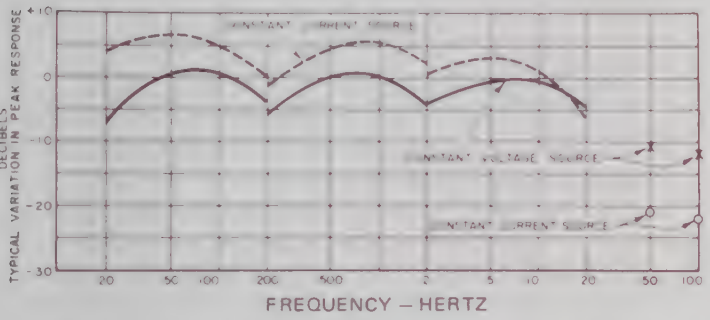


Figure 5. Typical variation in peak response with frequency for constant gain-control setting.

Service and Maintenance—Section 4

4.1 GR FIELD SERVICE.

Our warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone the nearest GR service facility (see back page), giving full information of the trouble and of steps taken to remedy it. Describe the instrument by type, serial, and ID numbers. (Refer to front and rear panels.)

Before returning an instrument to General Radio for service, please ask our nearest office for a "Returned Material" number. Use of this number in correspondence and on a tag tied to the instrument will ensure proper handling and identification. After the initial warranty period, please avoid unnecessary delay by indicating how payment will be made, i.e., send a purchase-order number or (for transportation charges) request "C.O.D."

For return shipment, please use packaging that is adequate to protect the instrument from damage, i.e., equivalent to the original packaging. Advice may be obtained from any GR office.

4.2 REMOVAL OF COVER.

To open the instrument for access to transistors and components, loosen the two fluted captive screws at the rear of the instrument and slide the U-shaped dust cover away from the panel. All transistors and components are now accessible.

4.3 BATTERY INSTALLATION.

The Type 1232-A Tuned Amplifier and Null Detector is powered by nine M72 mercury batteries (Mallory RM-4R or equivalent), which will last for over 1500 hours with normal use. For a simple check of the batteries, measure the dc voltage between anchor terminal 6 and ground. This should be 12 V.

To replace the batteries, remove the cap (twist counterclockwise and pull out) on the right-hand side of the instrument under the M72 CELLS engraving. Insert the 1¼ in. spacer (P/N 1232-6010) in the opening on the right-hand side of the instrument, under the M72 CELLS engraving. Push it in to the end of the compartment. Then, insert the nine batteries with the positive (+) terminal as marked on the battery facing into the instrument. Finally place the cap (battery-keeper assembly, P/N 1650-2120) in position, twisiting it approximately ¼ turn in either direction to lock it in position.

4.4 INTERNAL NOISE.

4.4.1 Noise Indicated by Meter.

At certain frequencies the sensitivity of the Type 1232-A Tuned Amplifier and Null Detector greatly exceeds the catalog specifications. With maximum gain at these frequencies, the noise generated by transistor Q100 normally causes large deflection of the output meter. For maximum useful gain, the GAIN control should be set low enough so that the noise level at the output is not greater than 10 percent of full scale.

For minimum sensitivity to hum pickup and stray fields, input connections must be shielded. Do not use an adaptor from the Type 874 INPUT connector to binding posts; use a shielded Type 874 cable.

If, with completely shielded input connections, the noise level of the Type 1232-A greatly exceeds the values given in Figure 6, the noise is probably caused by Q100. If it is necessary to replace this transistor, a replacement with a high β (beta) will usually give the lowest noise levels.

It is possible, but not likely, that Q101 will contribute significantly to the internal noise.

4.4.2 Noise From the Type 1232-P2.

The equivalent noise sources of the Type 1232-AP with the FILTER FREQUENCY set to 100 Hz are a current source of less than 0.1 $\mu\mu$A and a voltage source of less than 0.3 μV. If the noise levels of the Type 1232 alone do not exceed the values of Figure 6, yet the Type 1232-AP will not meet the above specifications, replace the transistor in the Type 1232-P2.

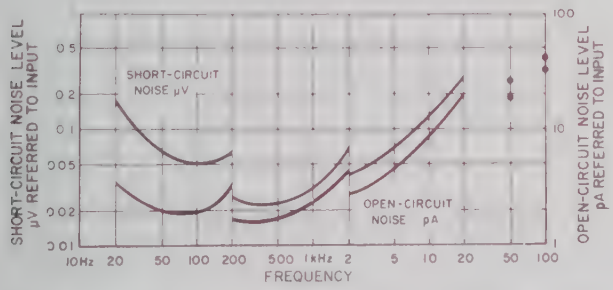


Figure 6. Typical noise levels as a function of frequency.

4.4.3 Output Noise.

Due to the large amount of amplification that follows the GAIN control there is always a small amount of noise present at the OUTPUT terminals. At minimum gain, and with the FILTER FREQUENCY control set to FLAT or with a FILTER FREQUENCY of 5 kHz or lower, this noise should be less than 50 mV with the METER switch set to MAX SENS and should cause no more than 1 per-

cent deflection of the output meter. With the METER switch set to LINEAR −20 dB, this noise should be less than 5 mV.

If the noise is greater than 50 mV with minimum gain and MAX SENS switch setting, the trouble is probably caused by Q200, Q201, or Q202. If this noise level is less than 50 mV and the noise with LINEAR −20 dB switch setting is greater than 5 mV, the faulty component is probably Q203, Q204, or Q205.

4.5 TRANSISTOR VOLTAGE AND RESISTANCE MEASUREMENTS.

Table 2 gives the normal voltage and resistance measurements from transistor terminals to ground. A deviation of 10 percent from any of these values is not necessarily abnormal.

1. Before making transistor voltage measurements, make sure that the battery voltage is approximately 12 V (refer to paragraph 4.3). Turn the instrument on but leave the GAIN control counterclockwise, set the FILTER FREQUENCY, switch to FLAT and the METER switch to LINEAR −20 dB. Measure voltage with a high impedance voltmeter.

2. Before making resistance measurements, remove all the batteries and short-circuit anchor terminal 6 to ground. Remove all transistors. Set the GAIN control to OFF, the FILTER FREQUENCY switch to FLAT, and the METER switch to LINEAR −20 dB.

TABLE 2
VOLTAGES AND RESISTANCES

Transistor (Type)	Term.	Dc Volts To Ground	Ohms To Ground	Transistor (Type)	Term.	Dc Volts To Ground	Ohms To Ground
Q100	C	7.8	222 k	Q202	C	0	0
	E	3.6	220 k		E	3.5	11 k
	B	3.7	3.3 M		B	3.3	22 k
Q101	C	11.6	2.2 k	Q203	C	1.7	100 k
	E	7.7	40 k		E	0.4	4.7 k
	B	7.8	222 k		B	0.5	42 k
Q200	C	7.4	34 k	Q204	C	3.6	47 k
	E	3.6	33 k		E	1.6	10 k
	B	3.7	120 k		B	1.7	100 k
Q201	C	3.3	22 k	Q205	C	7.2	4.4 k
	E	7.8	23 k		E	3.5	3.3 k
	B	7.4	34 k		B	3.6	47 k
Q101 of Type 1232-P2	D	12.0	3.2 k				
	S	0.7 to 2.5	10k				
	G	*	1 G				

* Impedance too high to permit measurement.

4.6 TRIMMER-CAPACITOR ADJUSTMENT.

Normally, the factory-set trimmer capacitor adjustment (C202) will not require attention. However, adjustment may be necessary if transistor Q201, Q203, or Q204 is replaced. If the frequency response for the FLAT characteristic is outside the specified limits, adjust the trimmer capacitor as follows:

a. With the FILTER FREQUENCY switch set at FLAT and a 1-kHz signal at the INPUT connector, adjust the GAIN control for a 5-dB meter indication.

b. With the GAIN and FILTER FREQUENCY controls unchanged, apply a 100-kHz signal (of the same amplitude as the 1-kHz signal) to the INPUT connector and adjust the trimmer capacitor, C202, for a meter indication of 5 dB. Check the frequency response below 100 kHz to make sure it is within the specified limits.

c. With same settings, use continuously variable source to check that response is flat within ±3 dB from 20 Hz to 100 kHz. Adjust with C202, if necessary.

4.7 MINIMUM PERFORMANCE STANDARDS.

4.7.1 General

The following tests are provided to demonstrate compliance of the 1232-A with published specifications at incoming inspection or following repair or calibration.

4.7.2 Test Equipment

The items listed in Table 3 are recommended for performance of the ensuing tests.

Table 3

Instrument	Recommended Type*
Decade Voltage Divider	GR 1455-B
Counter	GR 1192-B
Coaxial Adaptor	GR 874-Q10
Patch Cord	GR 776-A
Patch Cord	GR 776-B
Patch Cord	GR 274-NP
Shielded Patch Cord	GR 874-R34
Oscillator	GR 1310-B
Voltmeter	hp 400E
Short-Circuit Termination	GR 874-WNL
Open-Circuit Termination	GR 874-WO
Insertion Unit	GR 874-X
5.1 MΩ resistors, 5% (2 required)	———

*Or equivalent.

4.7.3 Noise Check

Connect the Voltmeter to the 1232-A OUTPUT terminals (via the 776-A Patch Cord and set controls as follows:

a. Voltmeter RANGE switch to 0.1 volts.

b. 1232-A METER switch to MAX SENS.

c. 1232-A FILTER FREQUENCY switch to FLAT.

d. 1232-A GAIN control on, but fully ccw.

The voltmeter indication (noise) should be .03-V maximum.

4.7.4 Filter Tuning Dial.

Connect equipment as shown in Figure 7.

Set controls as follows:

a. Set oscillator to 1 kHz at 1 V output.
b. Set 1455-B to .00100 (1 mV output.)
c. Set 1192 in FREQUENCY mode.
d. Set 1192 range switch to 1 s GATE TIME.
e. Set 1192 DISPLAY control at 1 s.
f. Set 1192 INPUT ATTEN at 1:1.
g. Set 1232-A FILTER FREQUENCY switch to 200 Hz – 2 kHz.
h. Set 1232-A METER switch to MAX SENS.

Set the FILTER TUNING dial on the 1232-A to each of the numbered points (2, 3, 4, 5, 7, 10, 15, 20) and adjust the 1232-A GAIN and the 1310 frequency for a peak reading on the 1232-A meter. In each case, the frequency read on the 1192 should be within ±3% of the nominal value on the 1232-A FILTER TUNING dial. (See Table 4).

Table 4
OSCILLATOR FREQUENCY SETTINGS

Hz	Hz
194-206	679-721
291-309	970-1030
388-412	1455-1545
485-515	1940-2060

Repeat the test at 100 Hz, 20 Hz, and 200 Hz on the 20-200 Hz range, and at 2, 10, and 20 kHz on the 2-20 kHz range. Also check 50- and 100-kHz (via the 1232-A FILTER FREQUENCY switch). In each case set the switch to its proper position before setting the frequency. The FILTER TUNING dial is not in the circuit at 50- and 100 kHz. At each step the FILTER TUNING dial should be accurate to within ±3% of the frequency read on the 1192.

4.7.5 Frequency Response

Set the following controls (same set-up as above):

a. Set oscillator to 1 kHz at 1 V output.
b. Set 1455-B to .01000 (10 mV.)
c. Set 1232-A FILTER FREQUENCY switch to FLAT.

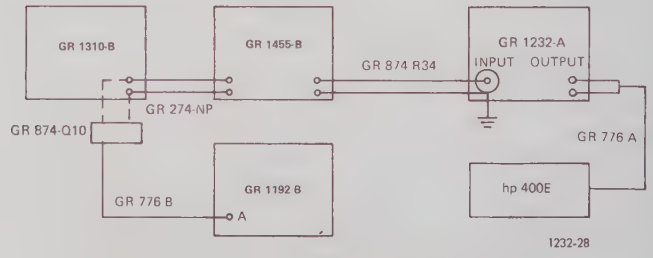


Figure 7. Filter Tuning Dial Test Set-up.

d. Set 1232-A METER switch to MAX SENS.

e. Adjust 1232-A GAIN for a 5 dB reading on the 1232-A meter. Change the frequency to 100 kHz and note a 1232-A meter reading of 2 - 8dB.

With a constant input voltage, the frequency response from 100 kHz to 20 Hz should be between 2 and 8 dB.

Repeat the test at 100 Hz, 10 kHz, 50 kHz, and 100 kHz, adjusting the GAIN control for a 5 dB deflection in each case. Adjust the output of the 1310-B to 1 V at the start of each frequency test.

4.7.6 Gain

Set the following:

a. Set oscillator to 1 kHz at 1 V output.
b. Set 1455-B to .9999X (1 V.)
c. Set 1232-A FILTER TUNING dial to 10.
d. Set 1232-A FILTER FREQUENCY switch to 200 Hz-2 kHz.
e. Set 1232-A METER switch to MAX SENS.

Under these conditions it must be possible to adjust the 1232-A GAIN control for a full-scale reading on the 1232-A meter.

Repeat the test for full-scale deflection with the 1455-B set to .00001 and the 1310-B adjusted to 100 mV.

Set the GAIN control 135° clockwise from the off position and adjust the 1455-B for a full scale reading of the 1232-A meter. The 1455-B should indicate between .00320 and .03200 (320 μV–3.2 mV.)

4.7.7 Meter Linearity

Set the following controls:

a. Set the oscillator to 1 kHz at 1 V output.
b. Set the 1455-B to .00320 (3.2 mV.)
c. Set the 1232-A FILTER FREQUENCY switch to FLAT.
d. Set the 1232-A METER switch to MAX SENS.

Adjust the GAIN control for full-scale (0 dB) on the 1232-A meter. Decrease the 1455-B output to 1.8 mV (65 dB); the 1232-A meter should indicate 4.7 to 5.3 dB.

Decrease the 1455-B output to 1 mV (.00100). The 1232-A meter should now read 9.5 to 10.5 dB.

Change the 1455-B output to 100 μV (.00010) and adjust the 1232-A GAIN for a full-scale reading on the 1232-A meter. Make the following checks:

1232-A METER switch	1455-B Output	1232-A meter must read:
–20 dB	.00010	5 to 7
LOG	.00010	40 to 60
LOG	.00010	Adjust GAIN to 20
LOG	.00100	60 to 90
LOG	.01000	80 to 100
LOG	.10000	greater than previous reading*

*If reading goes down, the batteries may need replacement.

4.7.8 Signal to Noise Ratio

Disconnect the 1192 from the set-up of Figure 7 and connect the voltmeter to the 1232-A OUTPUT. Set controls as follows:

a. Set oscillator to 20 Hz at 100 mV output.
b. Set 1232-A FILTER TUNING dial to 2.
c. Set 1232-A FILTER FREQUENCY switch to 20-200 Hz.
d. Set 1232-A METER switch to MAX SENS.

Disconnect the 1455-B from the 1232-A and short the 1232-A input with the 874-WNL. Adjust the GAIN control for an indication of 0.1 V on the voltmeter. Remove the input short and reconnect the 1455-B to the 1232-A INPUT. Adjust the 1455-B for an indication of 1.0 V on the voltmeter; this should require an output of 10 μV maximum on the 1455-B.

Repeat the above procedure, for the following conditions:

Frequency*	Setting†
1 kHz	3.5 μV
10 kHz	8 μV
100 kHz	30 μV

Set 1232 to 20 Hz. Disconnect the 1455-B and install the 874-WO at the 1232-A INPUT. Adjust GAIN for 0.1 V on the voltmeter. Remove the 874-WO. Connect, to the 1232-A input, a fixture consisting of two 5.1-MΩ resistors in series within the 874-X Insertion Unit. Connect the 1455-B to the other end of the fixture. With the oscillator at 20 Hz, adjust the 1455-B to produce a 1.0-V reading on the voltmeter. The 1455-B output should be 1 mV maximum.

Repeat the above procedure for the following conditions:

Frequency*	Setting†
1 kHz	700 μV
10 kHz	2 mV
100 kHz	15 mV

4.7.9 Harmonic Rejection

Use the set-up of Figure 7 and set controls as follows:

a. Set oscillator to 1 kHz at 100 mV.
b. Set 1455-B to .00001 (1 μV).
c. Set 1232-A FILTER TUNING dial at 10.
d. Set 1232-A FILTER FREQUENCY switch at 200 Hz-2 kHz.
e. Set 1232-A METER switch at MAX SENS.

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*Set filter tuning dials and filter frequency switch for appropriate frequencies.
†Max. 1455-B setting to give 1.0-V reading on hp400E.

Adjust the GAIN control for a full-scale reading on the 1232-A meter. Set the oscillator at the following frequencies, and in each case readjust the output of the 1455-B to give a full-scale reading of the 1232-A meter. The 1455-B should indicate as follows:

Frequency	Minimum 1455-B output voltage
2 kHz	63 μV (36 dB)
10 kHz	3.2 mV (70 dB)*
500 Hz	16 μV (24 dB)
60 Hz	1 mV (60 dB)

Reset the oscillator to 100 Hz and the 1455-B to 1 μV. With the 1232-A RANGE at 20-200 Hz, adjust the FILTER TUNING dial for a peak and adjust the GAIN control for a full-scale reading of the 1232-A meter. Change the oscillator to 200 Hz and readjust the 1455-B for a full-scale 1232-A meter reading. The 1455-B output must be 57 μV (35 dB) minimum.

Set the oscillator to 10 kHz (as indicated on the 1192-B) at a 100 mV output. Set the 1455-B to .01000 (1 mV). With the 1232-A range at 2-20 kHz, adjust the FILTER TUNING dial for peak response on the 1232-A meter. Adjust GAIN for full-scale deflection. Turn the FILTER TUNING dial ccw to obtain a meter reading 3 dB below full scale. Turn the oscillator frequency dial ccw through a peak meter indication and beyond, until the 1232-A meter again reads 3 dB below full scale. The frequency, indicated on 1192 should be between 10.30 and 10.50 kHz.

Reset the oscillator to 10 kHz, the 1455-B to 1 μV and the FILTER TUNING dial to 10. Tune the FILTER TUNING dial for a peak and adjust the GAIN for a full-scale deflection on the 1232-A meter. Change the oscillator to 20 kHz and readjust the 1455-B output for a full-scale reading on the 1232-A meter. The 1455-B must indicate 57 μV (35 dB) minimum.

Set the oscillator to 50 kHz, the 1455-B to .00005 (5 μV), and the FILTER FREQUENCY switch to 50 kHz. Adjust GAIN for full-scale on the 1232-A meter. Set the oscillator at the following frequencies, and in each case readjust the 1455-B output to give a full-scale reading on the 1232-A:

Frequency	Minimum 1455-B output voltage
100 kHz	1 mV (60 dB)
10 kHz	1.4 mV (63 dB)

Set the oscillator to 100 kHz at 100 mV output, the 1455-B to .00010 (10 μV), and the FILTER FREQUENCY switch to 100 kHz. Adjust GAIN for full-scale on the 1232-A. Set the oscillator at the following frequencies, and in each case readjust the 1455-B output to give a full-scale reading on the 1232-A:

*May not be able to get full-scale reading on 1232 with large input signal from 1455-B. Transistors in 1232 have reached max gain.

Frequency	Minimum 1455-B output voltage
20 kHz 200 kHz	1 mV (60 dB) 3.2 mV (70 dB)

4.7.10 External Filter

Set the oscillator to 10 kHz at 1 V output, the 1455-B to .00010 (100 μV), the FILTER FREQUENCY switch to FLAT, and the METER switch to MAX SENS. Connect the external filter, (set for 10-kHz band pass), to the EXTERNAL FILTER jack on the side of the 1232-A. Adjust the oscillator for peak reading on 1232-A, then adjust GAIN for full-scale. Change 1310 frequency to 100 kHz. Adjust the 1455-B for full-scale reading on the 1232-A meter. The 1455-B must indicate 1 mV (60 dB) minimum.

4.8 KNOBS

If it should be necessary to remove a 1232 knob, to replace a damaged switch or knob, proceed as follows:

a. Grasp the knob firmly with the fingers, close to the panel, and pull the knob straight away from the panel.

b. Observe the position of the set screw in the bushing with respect to any panel markings.

c. Release the set screw and pull the housing off the shaft, using an Allen wrench.

NOTE

To separate the bushing from the knob, if for any reason they should be combined off the instrument;drive a machine tap a turn or two into the bushing for sufficient grip for easy separation.

To install the snap-on knob assembly on the control shaft:

a. Mount the bushing on the shaft, using a small slotted piece of wrapping paper as a shim for adequate panel clearance.

b. Orient the set screw on the bushing with respect to the panel marking index and lock the set screw with an Allen wrench.

NOTE

Make sure the end of the shaft does not protrude through the bushing or the knob will not set properly.

c. Place the knob on the bushing with the retention spring opposite the set screw.

d. Push the knob in until it bottoms in the groove in the bushing.

NOTE

If the retention spring in the knob becomes loose, reinstall it in the interior notch with the small slit in the wall.

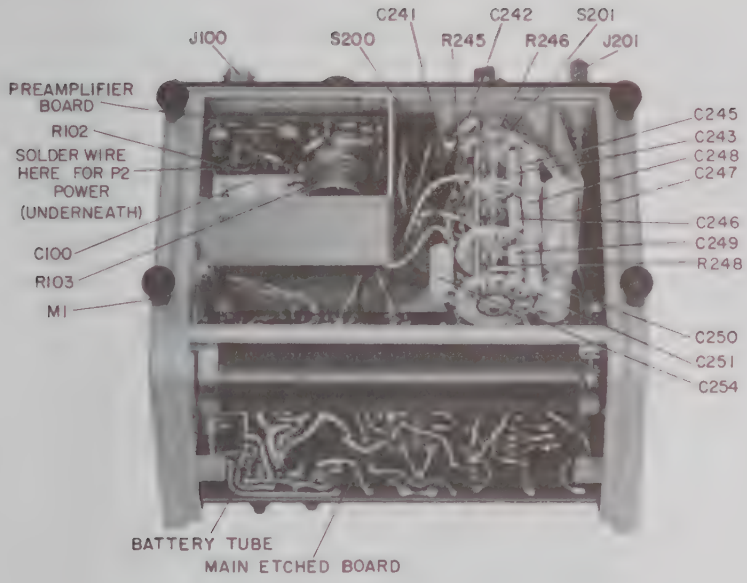


Figure 8. Bottom interior view of the Type 1232-A.

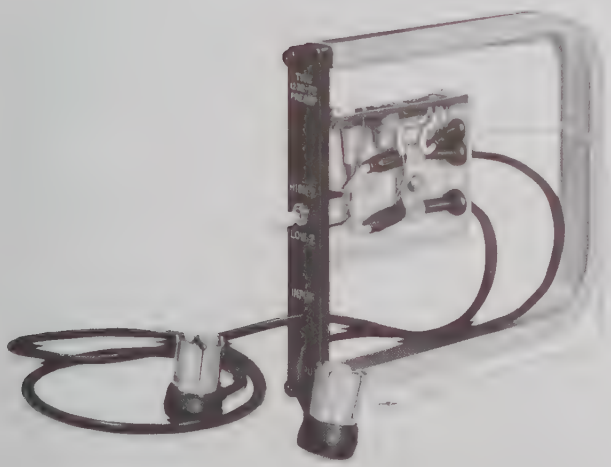


Figure 9. Interior of the Type 1232-P2.

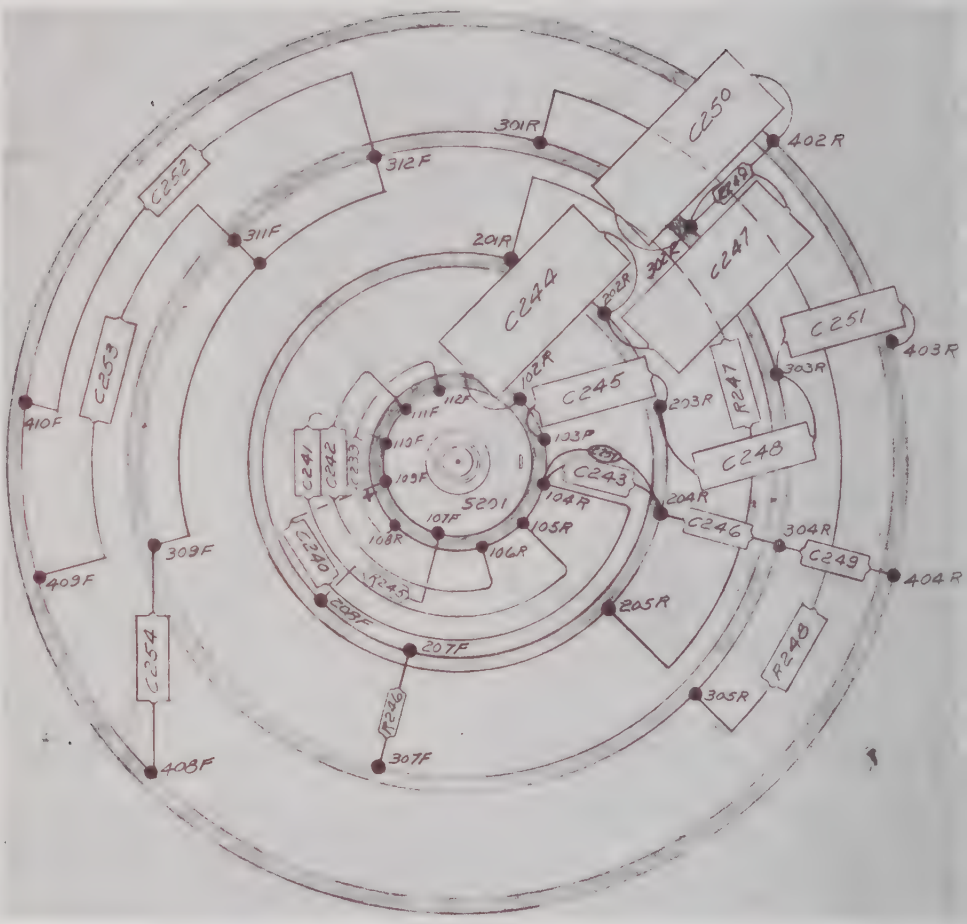


Figure 10. S201 wiring details. The 100-series lugs are at the panel end.

4.9 INSTRUMENT METER WINDOW CARE

The clear acrylic meter window can become susceptible to electrostatic-charge buildup and can be scratched, if improperly cleaned. It is treated inside and out in manufacturing with a special non-abrasive anti-static solution, Statnul*, which normally should preclude any interference in meter operation caused by electrostatic effects. The problem is evidenced by the inability of the meter movement to return promptly to a zero reading, once it is deenergized. As supplied, the meter should return to zero reading within 30 seconds, immediately following the placement of a static charge, as by rubbing the outside surface. This meets the requirements of ANSI standard C39.1-1972.

If static-charge problems occur, possibly as the result of frequent cleaning, the window should be carefully polished with a soft dry cloth, such as cheesecloth or nylon chiffon. Then, a coating of Statnul should be applied with the polishing cloth.

CAUTION

Do not use any kind of solvent. Kleenex or paper towels can scratch the window surface.

If it should be necessary to place limit marks on the meter window, paper-based masking tape is recommended, rather than any kind of marking pen, which could be abrasive or react chemically with the acrylic.

*Available from Mancib Co., Burlington, MA 01803

ELECTRICAL PARTS LIST

CHASSIS MOUNTED PARTS P/N 1232-3010

REFDES		DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
* BT	1	BATTERY 1.35V MERCURIC OXIDE M72	9410-1372	09823	HG-4R
		CAP TANT 6.8 UF 20PCT 6V	4450-4800	56289	150D685X0006A2
		CAP MYLAR .015UF 10 PCT 100V	4860-7655	56289	410P .015 UF 10PCT
		CAP MYLAR .0022UF 10 PCT 200V	4860-7329	56289	410P .0022 UF 10PCT
		CAP MYLAR .001UF 10 PCT 200V	4860-7309	56289	410P .001 UF 10PCT
		CAP MYLAR .00947UF 1 PCT 100V	4860-7553	56289	410P .00947 UF 1PCT
		CAP MYLAR 1UF 1 PCT 100V	4860-8003	56289	410P 1 UF 1PCT 100V
		CAP MYLAR .1UF 1 PCT 100V	4860-8249	56289	410P 0.1 UF 1PCT
		CAP MYLAR .01UF 1 PCT 100V	4860-7752	56289	410P .01 UF 1PCT
		CAP MYLAR 1UF 1 PCT 100V	4860-8003	56289	410P 1 UF 1PCT 100V
		CAP MYLAR .1UF 1 PCT 100V	4860-8249	56289	410P 0.1 UF 1PCT
		CAP MYLAR .01UF 1 PCT 100V	4860-7752	56289	410P .01 UF 1PCT
		CAP MYLAR 1UF 1 PCT 100V	4860-8003	56289	410P 1 UF 1PCT 100V
		CAP MYLAR .1UF 1 PCT 100V	4860-8249	56289	410P 0.1 UF 1PCT
		CAP MYLAR .0033UF 10 PCT 200V	4860-7359	56289	410P .0033 UF 10PCT
		CAP MYLAR .047UF 10 PCT 100V	4860-8203	56289	410P .047 UF 10PCT
		CAP MYLAR .22UF 10 PCT 100V	4860-7981	56289	410P 0.22 UF 10PCT
		CAP CER DISC 1000PF 5PCT 500V	4404-1105	72982	0831082Z5D0010IJ
J		PANEL CONNECTOR	0874-4181	24655	0874-4181
J		CONNECTOR JACK	4260-0400	82389	2J-1439
J		JACK SINGLE .080 PIN	4260-1010	98291	SKT-0804
J		BINDING POST ASM	0938-3000	24655	0938-3000
J		BINDING POST ASM	0938-3000	24655	0938-3000
M	1	METER	5730-1220	24655	5730-1220
		TRANSISTOR 2N4384	8210-1131	56289	2N4384
		TRANSISTOR 2N4384	8210-1131	56289	2N4384
		TRANSISTOR 2N4384	8210-1131	56289	2N4384
		TRANSISTOR 2N4250	8210-1294	07263	2N4250
		TRANSISTOR 2N4250	8210-1294	07263	2N4250
		TRANSISTOR 2N3903	8210-1132	04713	2N3903
		TRANSISTOR 2N3903	8210-1132	04713	2N3903
		TRANSISTOR 2N3903	8210-1132	04713	2N3903
R		RES COMP 1.8 K 5PCT 1/2W	6100-2185	81349	RCR20G182J
R		RES COMP 3.3 K 5PCT 1/2W	6100-2335	81349	RCR20G332J
R		RES FLM 19.6 OHM 1 PCT 1/2W	6450-9196	81349	RN65D19R6F
R		RES FLM 6.65K 1 PCT 1/2W	6450-1665	81349	RN65D6651F
R		RES COMP 200 K OHM 5PCT 1/2W	6100-4205	81349	RCR20G204J
R		POTENTIOMETER	0975-4040	24655	0975-4040
S		SWITCH TOGGLE 3POS DP STEADY	7910-0820	04009	82609
S		SWITCH ROTARY ASM	7890-2410	24655	7890-2410

TUNED AMPLIFIER PC BOARD P/N 1232-2701

REFDES		DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C	100	CAP MYLAR 0.15UF 10 PCT 600V	4860-9400	56289	411P 0.15 UF 10PCT
C	101	CAP TANT 1.0 UF 20PCT 35V	4450-4300	56289	150D105X0035A2
C	102	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C	103	CAP TANT 6.8 UF 20PCT 6V	4450-4800	56289	150D685X0006A2
C	104	CAP TANT 4.7 UF 20PCT 10V	4450-4700	56289	150D475X0010A2
CR	100	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR	101	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR	102	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR	103	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
R	100	RES COMP 3.3 M 5PCT 1/2W	6100-5335	81349	RCR20G335J
R	101	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R	102	RES COMP 2.2 K 5PCT 1/2W	6100-2225	81349	RCR20G222J
R	103	POTENTIOMETER	1232-0400	24655	1232-0400
R	104	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R	105	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R	106	RES COMP 18 K 5PCT 1/2W	6100-3185	81349	RCR20G183J
S	100	POTENTIOMETER	1232-0400	24655	1232-0400

* 9 BATTERIES REQUIRED

ELECTRICAL PARTS LIST

PC BOARD P/N 1232-2711

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C 200	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 201	CAP MICA 220 PF 5PCT 500V	4700-0519	81349	CM05FD221JN
C 202	CAP CER TRIM 8-50 PF	4910-1170	72982	557-051 E 8-50PF
C 204	CAP MICA 30 PF 5PCT 500V	4700-0237	81349	CM05ED300JN
C 205	CAP ALUM 200 UF 6V	4450-2610	56289	30D207G006
C 206	CAP MICA 100 PF 5PCT 500V	4700-0660	81349	CM05FD101JN
C 207	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C 208	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C 209	CAP MYLAR .22UF 10 PCT 100V	4860-7981	56289	410P 0.22 UF 10PCT
C 210	CAP TANT 10 UF 20PCT 20V	4450-5100	56289	150D106X002082
C 211	CAP CER TUB 680PF 5PCT 500V NM 0V NM	4404-1685	72982	315Z5R680PF10PCT500
C 212	CAP ALUM 5 UF 50 V	4450-3900	56289	30D505G050
C 213	CAP CER TUB 680PF 5PCT 500 V NM 0V NM	4404-1685	72982	315Z5R680PF10PCT500
C 214	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 215	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 216	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 217	CAP ALUM 15 UF 15V	4450-3700	56289	30D156G015
C 218	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 219	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 220	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 221	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 222	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 223	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 224	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 225	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 226	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 227	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 230	CAP MYLAR .01UF 2 PCT 100V	4860-7650	56289	410P .01 UF 2PCT
C 231	CAP MYLAR .00681UF 2 PCT 200V	4860-7505	56289	410P .00681 UF 2PCT
C 255	CAP TANT 4.7 UF 20PCT 10V	4450-4700	56289	150D475X0010A2
C 256	CAP MICA 1000 PF 5PCT 500V	4700-1190	81349	CM06FD102JN
CR 200	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 201	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 202	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 203	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 204	DIODE 1N191 90PIV IR 125UA GE	6082-1008	14433	1N191
CR 205	DIODE 1N191 90PIV IR 125UA GE	6082-1008	14433	1N191
L 201	CHOKE MOLDED 1000 UH 10PCT	4300-5000	99800	3500-32
L 202	CHOKE MOLDED 390 UH 10PCT	4300-4390	99800	3500-22
R 200	RES COMP 33 K 5PCT 1/2W	6100-3335	81349	RCR20G333J
R 201	RES COMP 33 K 5PCT 1/2W	6100-3335	81349	RCR20G333J
R 203	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 204	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R 205	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R 206	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 207	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 208	RES COMP 470 OHM 5PCT 1/2W	6100-1475	81349	RCR20G471J
R 210	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 211	RES COMP 10 OHM 5PCT 1/2W	6100-0105	81349	RCR20G100J
R 212	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 213	RES COMP 470 OHM 5PCT 1/2W	6100-1475	81349	RCR20G471J
R 214	RES COMP 110 K OHM 5PCT 1/2W	6100-4115	81349	RCR20G114J
R 215	RES COMP 150 K 5PCT 1/2W	6100-4155	81349	RCR20G154J
R 216	RES COMP 27 K 5PCT 1/2W	6100-3275	81349	RCR20G273J
R 217	RES COMP 47 K 5PCT 1/2W	6100-3475	81349	RCR20G473J
R 218	RES COMP 100 K 5PCT 1/2W	6100-4105	81349	RCR20G104J
R 220	RES COMP 4.7 K 5PCT 1/2W	6100-2475	81349	RCR20G472J
R 221	RES COMP 2.7 K 5PCT 1/2W	6100-2275	81349	RCR20G272J
R 222	RES COMP 47 K 5PCT 1/2W	6100-3475	81349	RCR20G473J
R 223	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 224	RES COMP 12 K 5PCT 1/2W	6100-3125	81349	RCR20G123J
R 225	RES COMP 3.9 K 5PCT 1/2W	6100-2395	81349	RCR20G392J
R 226	RES COMP 3.3 K 5PCT 1/2W	6100-2335	81349	RCR20G332J
R 227	RES COMP 1.8 K 5PCT 1/2W	6100-2185	81349	RCR20G182J
R 228	RES COMP 3.0 K OHM 5PCT 1/2W	6100-2305	81349	RCR20G302J
R 230	RES COMP 9.1 K OHM 5PCT 1/2W	6100-2915	81349	RCR20G912J
R 231	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 232	RES COMP 9.1 K OHM 5PCT 1/2W	6100-2915	81349	RCR20G912J
R 233	RES FLM 31.6K 1 PCT 1/8W	6250-2316	81349	RN55D3162F
R 234	RES FLM 31.6K 1 PCT 1/8W	6250-2316	81349	RN55D3162F

ELECTRICAL PARTS LIST (cont)

NULL DETECTOR PC BOARD P/N 1232-2711

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
R 235	RES FLM 3.32K 1 PCT 1/8W	6250-1332	81349	RN55D3321F
R 236	RES FLM 3.32K 1 PCT 1/8W	6250-1332	81349	RN55D3321F
R 237	RES FLM 40.2K 1 PCT 1/8W	6250-2432	81349	RN55D4022F
R 238	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 239	RES FLM 5.11K 1 PCT 1/8W	6250-1511	81349	RN55D5111F
R 240	RES FLM 5.11K 1 PCT 1/8W	6250-1511	81349	RN55D5111F
R 241	RES FLM 1.1K 1 PCT 1/8W	6250-1110	81349	RN55D1101F
R 242	RES FLM 4.99K 1 PCT 1/8W	6250-1499	81349	RN55D4991F
R 243	RES FLM 4.99K 1 PCT 1/8W	6250-1499	81349	RN55D4991F
R 244	RES FLM 1.05K 1 PCT 1/8W	6250-1105	81349	RN55D1051F
R 251	RES COMP 2.7 K 5PCT 1/2W	6100-2275	81349	RCR20G272J

MECHANICAL PARTS LIST

DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
FILTER TUNING KNOB ASM	5520-5520	24655	5520-5520
GAIN & FILTER FREQ KNOB ASM	5500-5221	24655	5500-5221
BATTERY HOLDER TUBE	1232-6000	24655	1232-6000
FILTER TUNING DIAL INDICATOR	5470-0650	24655	5470-0650
RIGHT END FRAME ASM	5310-3066	24655	5310-3066
LEFT END FRAME ASM	5310-3067	24655	5310-3067
FEET (4 REQUIRED)	5260-0700	24655	5260-0700

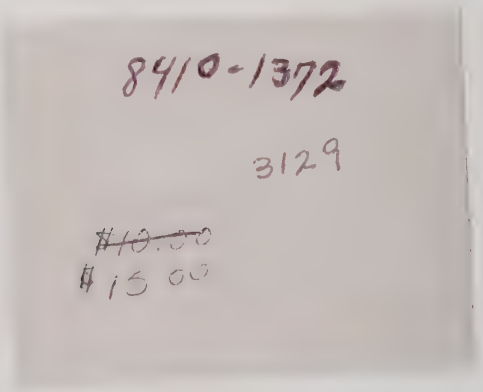
ELECTRICAL PARTS LIST

1232-P2 PREAMPLIFIER CHASSIS MOUNTED PARTS

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
S 101	SWITCH TOG MIN 2POS DPDT STEADY	7910-0791	95146	MTA-206N

1232-P2 PREAMPLIFIER PC BOARD P/N 1232-2730

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C 101	CAP MYLAR .001UF 10 PCT 200V	4860-7309	56289	410P .001 UF 10PCT
Q 101	TRANSISTOR 2N3457	8210-1082	17856	2N3457
R 101	RES COMP 1.0 G 20PCT 1/2W	6100-3108	81349	RCR20G108
R 102	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 103	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J



FEDERAL SUPPLY CODE
FOR MANUFACTURERS
From Defense Logistics Agency Microfiche
H4-2 SB 708-42 GSA-FSS H4-2

Ref FMC Column
in Parts Lists

Code	Manufacturer
00136	McCoy Electric, Mt. Holly Springs, PA 17065
00192	Jones Mfg., Chicago, IL 60181
00194	Nelson Electric, Los Angeles, CA 90018
00323	Welwyn Instrl., Westlake, OH 44145
00434	Schreiber Electric, Westbury, NY 11590
00656	Aerovox, New Bedford, MA 02746
00779	AMP Inc., Harrisburg, PA 17105
01009	Alden Products, Brockton, MA 02412
01121	Allen-Bradley, Milwaukee, WI 53204
01255	Litton Indls., Beverly Hills, CA 90213
01281	TRW, Lawndale, CA 90260
01295	TI, Dallas, TX 75222
01526	GE, Waynesboro, VA 22980
01930	Aerovox, Peachtree St., Atlanta, GA 30303
01962	Cherry Electr., Waukegan, IL 60085
02111	Spectrol Electronics, City of Industry, CA 91745
02114	Ferroxcube, Saugerties, NY 12477
02316	Fairchild Cam. & Instrument Co., Jamesburg, NJ 08831
02606	Computer Diode, S. Fairview, NJ 07022
02660	Amphenol, Broadview, IL 60153
02735	RCA, Somerville, NJ 08876
02768	Fenwal, Ashland, MA 01721
02842	Verbatim, Sunnyvale, CA 94086
02879	Stackpole Carbon, St. Marys, PA 15857
02954	Wickmann Werke, Inc., Monroe, NC 28110
03247	Corning Glass, Bradford, PA 16701
03262	Continental-Wirt Electronics, Philadelphia, PA 19140
03508	GE, Syracuse, NY 13201
03554	Raytheon, Quincy, MA 02169
03569	Sprague, Worcester, MA 01613
03797	Electronic Devices, Inc., Yonkers, NY 10701
03877	Transistor Electronics, Bloomington, MN 55420
03888	KDI Pyrofilm, Whippany, NJ 07981
03911	Claires, New York, NY 10001
04009	Arrow Hart, Hartford, CT 06106
04042	Gilfillan, Los Angeles, CA 90066
04713	Motorola, Phoenix, AZ 85008
04810	Component Mfg., Mt. Bridgeport, NJ 08079
04811	Midwest Components, Hudson, WI 54016
05245	Cannon, Chicago, IL 60630
05276	ITT Electron, Paramus, NJ 07652
05403	Cornish Conf. Artist, Melrose Pk., IL 60160
05574	Viking Inds., Chatsworth, CA 91311
05624	Burtal Corbman, Stockton, IL 61101
05748	Barnes Mfg., Mansfield, OH 44901
05820	Waterfall Eng., Wallingford, CT 06492
06383	Pandjiris, Toms River, NJ 08753
06540	Amatom Electronic Hardware, Sayreville, NJ 08872
06665	Precision Monolith, Santa Clara, CA 95050
06743	Electra, Cleveland, OH 44110
06785	MIL-S Stamp, Chesterland, OH 44026
06915	Rishon Elec., Chicago, IL 60640
06928	Teledyne Relays, Hawthorne, CA 90250
06976	Aladdin Electra., Nashville, TN 37210
07137	Elgin Nat. Watch, Elgin, IL 60120
07182	Power Conversion, Buffalo, NY 14240
07207	Gigit Signal, Bandon, WI 53913
07233	Coach Supply, City of Industry, CA 91744
07261	Avnet, Culver City, CA 90230
07263	Fairchild, Mountain View, CA 94040
07387	Birtcher, S. Los Angeles, CA 90022
07395	Amp Sentramid, Arlington Hts., IL 60004
07459	Magnetic Core, Newburgh, NY 12550
07480	Gudeman Co., Chicago, IL 60622
07533	Sealtron, Bridgeport, NJ 08014
07629	Bodine Electr., Chicago, IL 60618
07910	Corr Devlac, Hawthorne, CA 90250
07983	State Labs., New York, NY 10022
07999	Amp Inc., Harrisburg, PA 17105
08024	Deutsch Fastener, Los Angeles, CA 90040
08106	Self Elect., Chicago, IL 60631
08730	Vitramon Prod., Franklin Lakes, NJ 07417
08813	GE, Buffalo, NY 14240
08863	C&K Components, Watertown, MA 02172
08865	Bunker Ramo, Oak Brook, IL 60521
08923	Sprague Battery, Poquonock, CT 06064
09856	Fenwal Electra., Framingham, MA 01701
09922	Burndy, Norwalk, CT 06852
10025	Glastrol Prod., Linden, NJ 07036
10089	Chicago Switch, Chicago, IL 60647
11236	CTS of Berne, Berne, IN 46711
11311	Cherry Electr., Waukegan, IL 60031
11502	Northwest, Minneapolis, MN 55427
11640	Birnbach Radio, Harrison, NJ 07029
11845	Elcro Transducer, Flushing, NY 11354
11906	Teledyne, Mountain View, CA 94043
11911	Hamlin, Lake Mills, WI 53551
12072	RCA, Woodbridge, NJ 07095
12697	Clarostat, Dover, NH 03820
12954	Micrometals, City of Industry, CA 91744
12969	Unitrode, Watertown, MA 02172
13084	Electrocube, Inglewood, CA 90301
13103	Thermalloy, Dallas, TX 75201
13148	Vogue Inst., Richmond Hill, NY 11418
13150	Ventron, Lowell, MA 01851
13237	Sealtron Devices, Tappan, NY 10983
13715	Fairchild, San Rafael, CA 94903
13919	Burr Brown, Tucson, AZ 85706
14099	Sylvania, Woburn, MA 01888
14140	Electra Controls, Wyckoff, NJ 07481
14191	American Labs., Fullerton, CA 92634
14222	Astron, Amelia, OH 45102
14433	ITT, JF Palm Beach, FL 33402
14482	Wakins & Johnson, Palo Alto, CA 94304
14606	Carlon, Berlin, CT 06037
14655	Cornell Dubilier, Newark, NJ 07101
14674	Corning Glass, Corning, NY 14830
14752	Electro Cube, Inglewood, CA 90301
14771	Electronic Sol., Culver City, CA 91779
14889	R&O Steel, Sun Valley, CA 91352
14936	Electr. Hat & Electr., Providence, MA 02190
14936	General Instr., Hicksville, NY 11802
15238	ITT, Lawrence, MA 02142
15476	Digital Equip., Maynard, MA 01754

Code	Manufacturer
15605	Cutler Hammer, Milwaukee, WI 53202
15782	Hexacon Inst., Bellaire, TX 77401
15891	Fenwal Electra., Framingham, MA 01701
15910	Sinclair & Rush, St. Louis, MO 63111
15937	Trimm Electr., Grove City, OH 43123
16080	Irvine Diode, Jersey City, NJ 07304
16179	Omni Spectra, Farmington, MI 48024
16291	Aerovox, Linden, NJ 07036
16299	Corning Glass, Corning, NY 14830
16402	Sterling Inst., New York, NY 11040
16530	Indiana General, Oglesby, IL 61348
16758	Delco, Kokomo, IN 46901
16850	Precision Dynamics, Burbank, CA 91504
16852	Amer Mach Foundry, Summerville, SC 29482
17117	Elcro Molding, Wisconsin Rt. 32850
17540	Midwest Spring, Schiller Park, IL 60176
17748	Amphenol Prec., Wagoneer, WV 25780
17856	Siliconix, Santa Clara, CA 95054
17901	Zahn, Concord, CA 94520
17990	Siliconix, Santa Clara, CA 95054
18324	Signetics, Sunnyvale, CA 94086
18540	New Prod Eng., Attleboro, MA 02760
18677	Sowles, El Monte, CA 91731
18736	Computer Diode, S. Fairview, NJ 07936
18796	Omron, Sunnyvale, CA 94086
18878	Zenith, Chesterland, OH 53084
18916	Sprague, North Adams, MA 01247
18920	Solitron Devices, Inc., Riviera Bch., FL 33404
19047	Sola Electr., Elk Grove Village, IL 60007
19117	Gilfillan, Van Nuys, CA 91406
19199	Stackpole Carbon, St. Marys, PA 15857
19207	Sylvania Electr. Prod., Woburn, MA 01888
19260	Stanford Applied Eng., Santa Clara, CA 95054
19315	Elmenco, Attleboro, MA 02703
19500	Peerless Electr., Warren, PA 16365
19505	Applied Devices, Lodi, NJ 07644
19647	Xcelite, Orchard Park, NY 14127
19701	Electra Indep., Mineola, NY 11501
19716	Technical Wire, Pawling, NY 12564
19793	Kulka Electr., Mt. Holly Springs, PA 17065
20186	Allen Bradley, Milwaukee, WI 53204
20205	Magnetic Metals, Camden, NJ 08101
20269	Faraday Labs., Worcester, MA 01604
20284	Int'l Rectifier, El Segundo, CA 90245
20303	Gen Cable, Bayonne, NJ 07002
20354	Kenyon Transf., Jersey City, NJ 07304
20365	Semtech, Newbury Park, CA 91320
20460	Technical Wire, Pawling, NY 12564
20481	Int'l Rectifier, El Segundo, CA 90245
20551	Cinch Connector, Elk Grove Village, IL 60007
20601	Curtis Indus., Milwaukee, WI 53214
20605	Cannon Electr., Phoenix, AZ 85029
20932	Monadnock Paper, Bennington, VT 05201
21029	Vitramon, Bridgeport, CT 06601
21118	Chicago Miniature, Chicago, IL 60656
21139	Bussman, Beacon Falls, CT 06403
21276	Comlinear, Fairchild Cam., Campbell, CA 95008
21298	Cornell Dubilier, Newark, NJ 07101
21452	Keystone Carbon, St. Marys, PA 15857
21520	Fairchild Cam. & Instrument Co., Mountain View, CA 94040
21698	Fluke, Everett, WA 98206
21845	Siliconix, Santa Clara, CA 95054
21847	Airpax Electr., Cambridge, MD 21613
21850	Arco Electr., Clear Brook, VA 22624
21856	Solitron Devices, Jupiter, FL 33458
22110	Consolidated Controls, Bartlesville, OK 74003
22229	Sola Const. Serv., Addison, IL 60101
22273	Amphenol, Broadview, IL 60153
22526	Berg Electr., New Cumberland, PA 17070
22670	Electra Speer Resistor, Greenville, SC 29602
22753	Tektronix, Beaverton, OR 97077
22885	Fairchild, Mountain View, CA 94040
23050	Varo Semiconductor, Garland, TX 75040
23119	Semtech, Newbury Park, CA 91320
23142	Electra Speer Resistor, Greenville, SC 29602
23179	Perfection Mica, Bensenville, IL 60106
23183	Sensitive Research, Berkeley, CA 94710
23186	Tung-Sol, Bloomfield, NJ 07003
23199	Stewart Stamping, Yadkinville, NC 27055
23223	Hi-Q Division, Aerovox, New Bedford, MA 02745
23269	Vitramon, Bridgeport, CT 06601
23331	Potter & Brumfield, Princeton, IN 47671
23342	Oxley Developments, Northbridge, NSW 2063
23399	Stanford Applied Eng., Santa Clara, CA 95054
23594	Mallory Distributor, Indianapolis, IN 46206
23630	Barker & Williamson, Bristol, PA 19007
23691	Alpha Wire, Elizabeth, NJ 07207
23737	Sperry Rand, Gainesville, FL 32602
23880	Amperex Electr., Hicksville, NY 11802
23936	Hexacon Inst., Bellaire, TX 77401
24226	Corning Glass, Bradford, PA 16701
24228	Corning Glass, Raleigh, NC 27604
24355	Gen Cable, Bayonne, NJ 07002
24446	Sylvania Electr. Prod., Woburn, MA 01888
24484	Mallory Sonalert, Indianapolis, IN 46206
24655	General Radio, W. Concord, MA 01781
24681	Industrial Timer, Parsippany, NJ 07054
24759	Sprague, Concord, NH 03301
24931	Specialty Connector, Indianapolis, IN 46206
24940	Raytheon, Quincy, MA 02169
25003	Lorain Prods., Lorain, OH 44052
25042	Sprague, Worcester, MA 01613
25088	Mepco/Centralab, Fort Wayne, IN 46801
25120	Nytronics, Berkeley Hts, NJ 07922
25142	Delphi, Sandusky, OH 44870
25179	Sylvania Electr. Prod., Woburn, MA 01888
25220	Standard Coil, Lafayette, IN 47902
25333	Bourns, Riverside, CA 92507
25376	Kester, Chicago, IL 60639
25403	Int'l Rectifier, El Segundo, CA 90245
25446	Stanford Applied Eng., Santa Clara, CA 95054
25753	Amperex Electr., Hicksville, NY 11802
25778	Essex Wire, Fort Wayne, IN 46804
25818	Electro Motive, Willimantic, CT 06226
25854	Pyrofilm Resistor, Whippany, NJ 07981
25909	Sprague, Concord, NH 03301
26119	Sylvania Electr. Prod., Woburn, MA 01888
26365	Lenox Fuse, Shelbyville, IN 46176
26462	Fenwal Electra., Framingham, MA 01701
26480	Standard Pressed Steel, Jenkintown, PA 19046
26487	Litton Indls., Beverly Hills, CA 90213
26490	Keystone Carbon, St. Marys, PA 15857
26742	Philips ECG, Smithtown, NY 11787
26982	Augat Inc., Attleboro, MA 02703
27014	National Semiconductor, Santa Clara, CA 95051
27038	Airpax Electr., Cambridge, MD 21613
27090	Clarostat, Dover, NH 03820
27117	Industrial Timer, Parsippany, NJ 07054
27142	Powertec, Van Nuys, CA 91406
27154	Allen Bradley, Milwaukee, WI 53204
27180	Hamlin, Lake Mills, WI 53551
27264	Vactec, Bridgeton, MO 63044
27266	Stanford Applied Eng., Santa Clara, CA 95054
27367	Tusonix, Tucson, AZ 85706
27380	Hartford Universal Ball, Rocky Hill, CT 06067
27401	Tilton, Pleasantville, NJ 08232
27412	Hexacon Mfg., Kenilworth, NJ 07033
27499	Bassett Industries, Oxford, NC 27565
27740	Triad-Utrad, Huntington, IN 46750
27871	Dage Electr., Michigan City, IN 46360
27975	Sola Basic Indus., Milwaukee, WI 53209
28480	Hewlett-Packard, Palo Alto, CA 94304
28483	Haydon, Forestville, CT 06011
28520	Heyman Mfg., Kenilworth, NJ 07033
28750	Bussman, St. Louis, MO 63107
28876	Int'l Rectifier, El Segundo, CA 90245
28959	Hoffman Electr., El Monte, CA 91734
28960	Bendix, Sidney, NY 13838
29044	Sola Const. Serv., Addison, IL 60101
29117	Kraco Enterprises, Compton, CA 90220
29448	Weckesser, Chicago, IL 60630
29504	Sylvania Electr. Prod., Woburn, MA 01888
29582	Sprague, North Adams, MA 01247
29735	Stimpson, Bayport, NY 11705
29813	Superior Trans., Washington, PA 15301
29850	Thomas & Betts, Elizabeth, NJ 07207
29875	TRW, Cleveland, OH 44117
29899	Torrington, Torrington, CT 06790
29927	Townsend, Bishopville, MD 21856
29937	Union Carbide, New York, NY 10017
29981	Unitrode, Watertown, MA 02172
30069	Victoreen, Cleveland, OH 44104
30140	Vishay Intertech., Malvern, PA 19355
30264	Weston, Newark, NJ 07114
30429	Anaheim Cap., New Bedford, MA 02742
30569	Adams & Westlake, Elkhart, IN 46514
30983	Chrysler, Detroit, MI 48231
30985	Atlantic India Rubber, Chicago, IL 60607
31001	Cambridge Thermionic, Cambridge, MA 02138
31827	Zahn, Concord, CA 94520
31918	Best Chain, Bridgeport, CT 06602
31959	Belden, Chicago, IL 60644
31964	Bremen, Beaver Falls, CT 06403
31976	Cambridge Thermionic, Cambridge, MA 02138
32293	Centralab, Clinton Forge, VA 24422
32439	Rosemont, Jo Louis, MO 63107
32464	CTS, Elkhart, IN 46514
32502	Cornell Dubilier, Newark, NJ 07031
32603	Corn, Chicago, IL 60640
32660	Centralab, Milwaukee, WI 53212
32665	Continental Carbon, New York, NY
32707	Corp Coil, Providence, RI 02905
32709	Crescent Ind., Philadelphia, PA 19134
32744	Chicago Min Lamp, Chicago, IL 60640
32767	Sprague, Worcester, MA 01613
32770	Dialight, Brooklyn, NY 11221
32796	Electro Motive, Willimantic, CT 06226
32828	Continental Screw, New Bedford, MA 02743
32882	Hytronics, Berkeley Hts, NJ 07922
32897	Dialight, Brooklyn, NY 11237
32989	General Inst., Newark, NJ 07104
33095	Dale, Columbus, NE 68601
33264	Dow Fastener, Mt Holly, NY 11788
33297	Elec Hardware, Bronx, NY 10466
33325	Spectrol Electronics, Ontario, CA 91761
33361	Sola Basic Indus., Milwaukee, WI 53209
33403	Amperex Electr., Hicksville, NY 11802
33488	Carling Electr., Hartford, CT 06110
33508	Elco Resistor, New York, NY
33602	TI, Attleboro, MA 02703
33660	JFD Electr., Brooklyn, NY 11210
33907	Grayhill, La Grange, IL 60525
34029	Quam Nichols, Chicago, IL 60637
34445	Helix-Koone, Hamilton, CT 06110
34649	Hutsell, Stratford, CT 06497
34681	Industrial Crafter, Chicago, IL 60618
34761	Amphenol, Danbury, CT 06810
34870	Johnson, Waseca, MN 56093
34899	HOTTR, Burlington, IA 52601
35378	Kurz-Kasch, Dayton, OH 45401
35434	Lectrohm, Chicago, IL 60607
35699	Lafayette, Syracuse, NY 11501
35808	Linden, Providence, RI 02905
35814	Lindflex, Des Plaines, IL 60016
35909	Lord Mfg., Erie, PA 16512
36179	Mallory Electr., Detroit, MI 48204
36341	Mepco, Chicago, IL 60618
36481	3 M Co., St. Paul, MN 55101
36486	Minor Rubber, Bloomfield, NJ 07003
36570	Monadnock Paper, Lowell, MA
36654	Mueller Electr., Cleveland, OH 44114
36884	National Tube, Pittsburg, PA
36954	Oak Indls., Crystal Lake, IL 60014
37132	Dort Fastener, Waterbury, CT 06720
37136	Patton MacGuyer, Providence, RI 02905
37188	Pyle Stemtor, Syracuse, NY 13209
37250	Penn Roberts Rubber, Trenton, MI 48183
37365	Shuttleworth, Elgin, IL 60120
37442	Rex-o-Vac, Madison, WI 53703
37820	TRW, Camden, AR 71701
37928	General Inst., Brooklyn, NY 11211
37942	Shuttleworth, Elgin, IL 60120
37977	Sigma Inst., Braintree, MA 02184
38229	Amco Speer, St Marys, PA 15857
38283	Stackpole, St Marys, PA 15857
38473	Stanford Applied, Santa Clara, CA
38711	Teledyne, Huntington, NY 11743
39269	RCA, Harrison, NJ 07029
39314	Welsh Scientific, New York, NY 11101
39467	Western Rubber, Goshen, IN 46526
39725	Winewski, Hartford, CT 06110
39727	Continental Wirt, Philadelphia, PA 19101
39840	Mallory Controls, Frankfort, IN 46041
39963	Electro Cube, Inglewood, CA 90301
40002	Components, Pelo Alto, CA 94304
40033	Precision Fastener, Toledo, OH 43666
40046	Victoria, St Louis, MO 63108
40210	Lambda, Melville, NY 11746
40383	Sprague, N. Adams, MA 01247
40511	Monsido, Franklin Pk., IL 60131
40581	Formica, Cincinnati, OH 45232
40598	Standard Oil, Lafayette, IN 47902
40760	Bourns, Lake Forest, CA 92630
40920	Bourns, Riverside, CA 92507
40921	Air Filter, Milwaukee, WI 53210
40982	Hennessy Ind., New York, NY 10010
41240	Beckman Inds., Fullerton, CA 92634
41502	TRW Ravsey, St. Louis, MO 63102

Code	Manufacturer
50884	Pure Carbon, St Marys, PA 15857
51030	Int'l Inst., Orange, CT 06417
51073	Grayhill, LaGrange, IL 60525
51163	Isolantite, Stirling, NJ 07980
51313	Winchester, Glenville, CT 06778
51349	Military Specifications
51360	Joint Army-Navy Specifications
51463	Int'l Rectifier, El Segundo, CA 90245
51642	Centralab, Milwaukee, WI 53201
51831	Filtron, Flushing, NY 11354
51940	Ledex, Dayton, OH 45402
51960	Burr-Wright, Watertown, MA 02172
52210	Sylvania, Emporium, PA 15834
52227	Nu-Ance Phillips, Bradley, CT 06418
52273	IN Patsen & Model, LaPorte, IN 46350
52960	Sealtron, Bridgeport, NJ 08530
52967	Reeves Hoffman, Carlisle, PA 17013
53387	Minnesota Rubber, Minneapolis, MN 55303
53657	Milwaukee Resistor, Milwaukee, WI 53204
53877	Ryerson, Woodstock, NY 13498
53961	Int General Magnet, Hoboken, NY 48265
53993	Varo, Garland, TX 75040
53014	Metzner, Mt Carmel, IL 62863
53033	Metzner, Mt Carmel, IL 62863
53058	Carr Fastner, Cambridge, MA 02142
53186	Victory Eng., Springfield, NJ 07081
53198	Vitramon, Bridgeport, CT 06601
53232	H.H.Smith, Brooklyn, NY 11207
53381	Bearing Spply, San Francisco, CA
53387	Solar Electron, Dallas, TX 75393
53564	Burroughs, Plainfield, NJ 07061
53740	Amperex Electr., New York, NY 10017
53788	Mee Engrg., Quincy, MA 02171
53797	Mallory Electr., Detroit, MI 48234
53801	Int General Magnet, Hoboken, NY 48265
54053	Lehigh Metals, Cambridge, MA 02140
54294	Sorbe Tantalum, Bloomington, IN 47401
54871	TA Mfg., Los Angeles, CA 90039
55004	Kraco, Rowland Hts., CA 91748
55020	Payson Casters, Gurnee, IL 60031
55077	Pmc Metal Prod., Brooklyn, MA 02180
55084	RCA, Harrison, NJ 07029
55111	Sprague, Concord, NH 03301
55322	Dann Stamp, Brooklyn, NY 11220
55142	Cutler Hammer, Lincoln, IL 62656
55236	CTS Sylvania, Waterloo, IA 51030
55219	Gould Nat Batterry, Trenton, NJ 08607
55419	Cornell Dubilier, Fuquay Varina, NC 27526
55427	KBG Mfr., New York, NY
55565	Potter & Brumfield, Princeton, IN 47671
55493	Hohner Cabot, Boston, MA 02119
55679	Bussman, St. Louis, MO 63107
55719	Berkshire Transformer, Kent, CT 06757
55951	Mallory Cap, Indianapolis, IN 46206
55963	Mallory Sat., Tarrytown, NY 10591
56034	Guiton Indls., Mitroften, NJ 08840
56790	Westinghouse, Bamboo, MA 02118
56982	Hardware Prod., Reading, PA 19603
57042	Centralab Mfg., Scio, PA 17165
57124	Garron, Boon, MA 01810
57668	Bussman, Beacon Falls, CT 06403
57703	Johnson, Waseca, MN 56093
57917	Harris, Melbourne, FL 32901
57961	Augat Bros. Attleboro, MA 02703
57988	Chandler, Wethersfield, CT 06109
57977	Dale Electr., Columbus, NE 68601
57982	Elco, Willow Grove, PA 19090
58181	General Instr., Dallas, TX 75220
58258	Kings Electr., Tuckahoe, NY 10707
58474	Honeywell, Freeport, IL 61032
58529	Honeywell, Freeport, IL 61032
58918	Electro Instr., Woodside, NY 11377
58924	Edgerton Germeshausen, Boston, MA 02118
58992	IMC Magnetics, Westbury, NY 11591
59730	Amphenol, Chicago, IL 60608
59888	Hudson Lamp, Kearny, NJ 07032
59933	Sylvania, Ipswich, MA 01980
59946	Amer Electric Lab., Lansdale, PA 19446
59959	Tel Labs, Chicago, IL 60672
59962	Tel Labs, Chicago, IL 60672
59963	Raytheon, Quincy, MA 02169
59964	Wagner Electr., Lexington, KY 40509
59970	Weston, Archbold, PA 18403
59972	Tel Labs, Chicago, IL 60672
59980	Dickson, Chicago, IL 60618
59981	Waterman, Chicago, IL 60620
59985	Allen Ind., Brooklyn, NY 11233
59986	Amer Precision, Greenville, SC 29602
60121	Delta Circuit, St Marys, PA 15857
60148	Alco Electr., Lawrence, MA 01843
60180	Cardinal Components, Woodside, NY 11377
60275	Vitramon, Bridgeport, CT 06601
60348	Carbon, Boston, MA 02103
60354	Methode, Rolling Meadow, IL 60008
60380	Mallory Distributor, Indianapolis, IN 46206
60381	Winchester, Chicago, IL 60640
60386	Aerovox Int G., Olean, NY 14760
60541	Microwave Assoc., Burlington, MA 01801
60608	Military Standards
60918	Lineweaver Switch, Woodstock, CT 06281
60931	Siebe Inc., Bannockburn, IL 60644
60974	Conap, Burlingame, CA 94010
60991	North Hills, Glen Cove, NY 11542
61077	Trans-Tronics, Bensenville, IL 60106
61637	Metzner, Flushing, NY 11358
62013	Varian, Palo Alto, CA 94303
62119	Atlee, Winchester, MA 01890
62600	Delevan, E. Aurora, NY 14052
62634	Fairchild, Boston, MA 02118
62642	Centralab, Milwaukee, WI 53201

NOTES:
RESISTORS 1/2 WATT UNLESS OTHERWISE SPECIFIED
RESISTANCE IN OHMS UNLESS OTHERWISE SPECIFIED
K = 1000 OHMS M = 1 MEGOHM
CAPACITANCE VALUES ONE AND OVER IN MICRO-MICROFARADS (PICOFARADS), LESS THAN ONE IN MICROFARADS, UNLESS OTHERWISE SPECIFIED

○ KNOB CONTROL

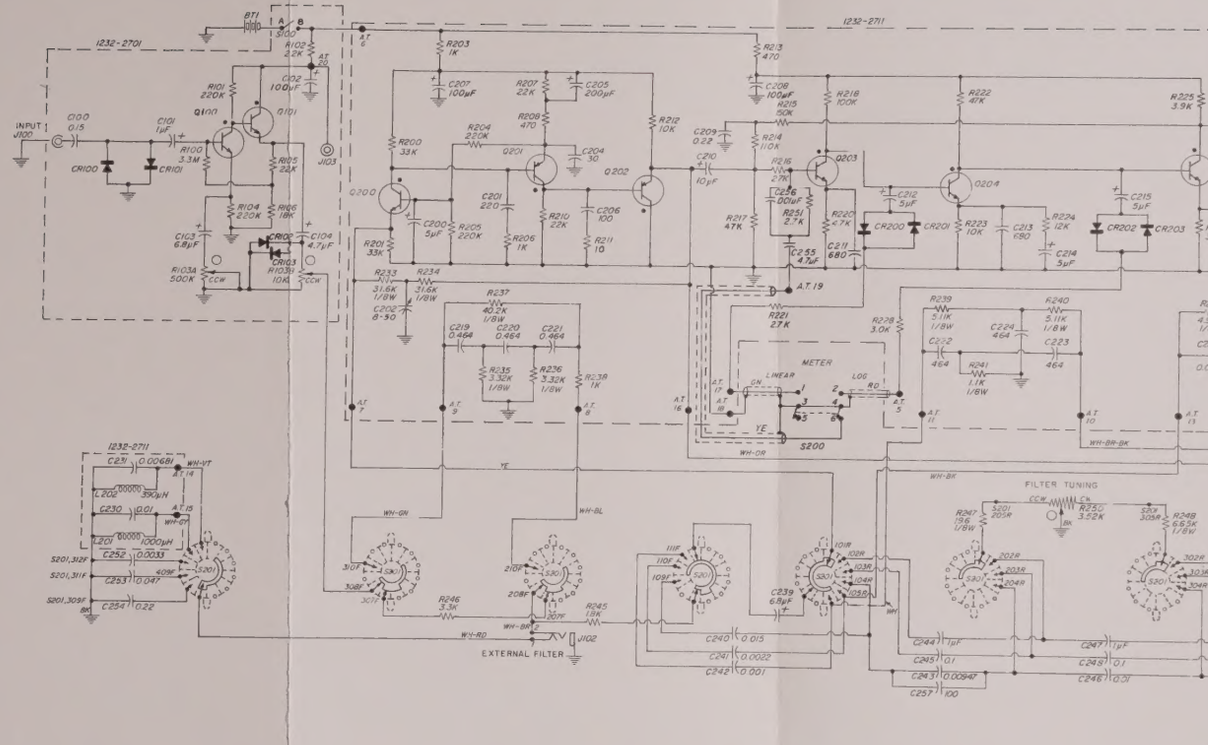
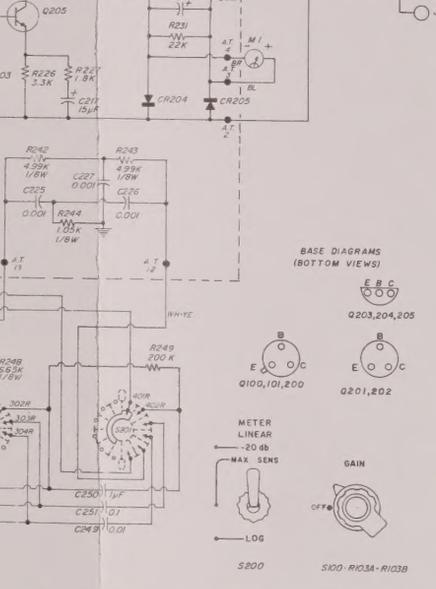


Figure 11. Schematic diagram of the Type 1232-A Tuned Amplifier and Null Detector.

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.



FILTER FREQUENCY

S201 SWITCHING DIAGRAM							
SWITCH POSITION	SWITCH SECTIONS						
	1F	1R	2F	2R	3F	3R	4F	4R
FLAT	7-12	1-8	7-8		7-8			
20-200Hz	7-12	1-2	7-8	1-2	7-8	1-2	7-8	1-2
200Hz-2mHz	7-12	1-3	8-10	1-3	8-10	1-3	7-9	1-3
2mHz-20mHz	7-9	1-4	8-10	1-4	8-10	1-4	7-10	1-4
50mHz	7-10	1-5	8-10		8-10		7-11	1-5
100mHz	7-11	1-6	8-10		8-10		7-12	1-6

S201 SHOWN IN EXTREME COUNTERCLOCKWISE POSITION

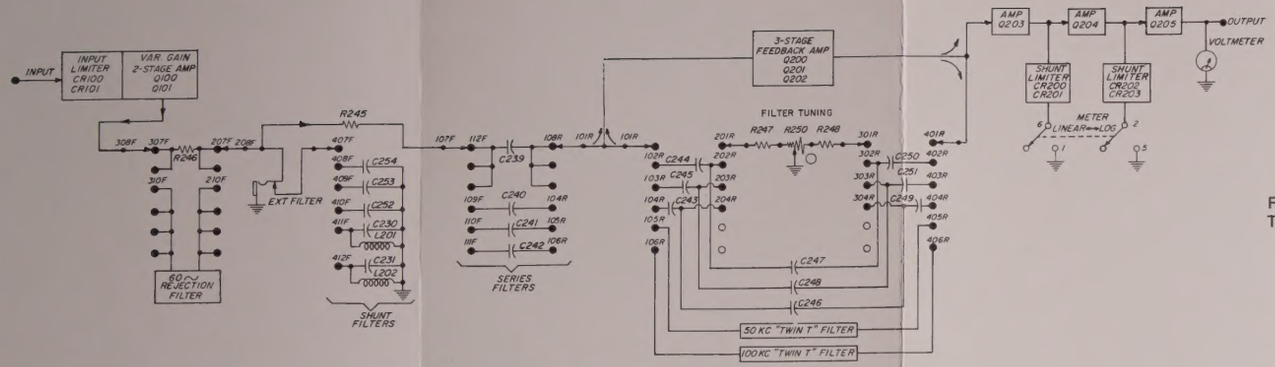


Figure 12. Block diagram of the Type 1232-A Tuned Amplifier and Null Detector.

NOTE: The number appearing on the foil side is not the part number. The dot on the foil at the transistor socket indicates the collector lead.

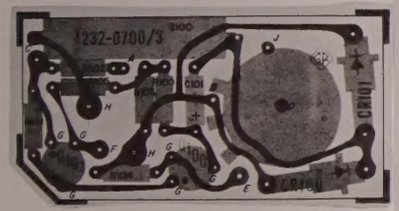
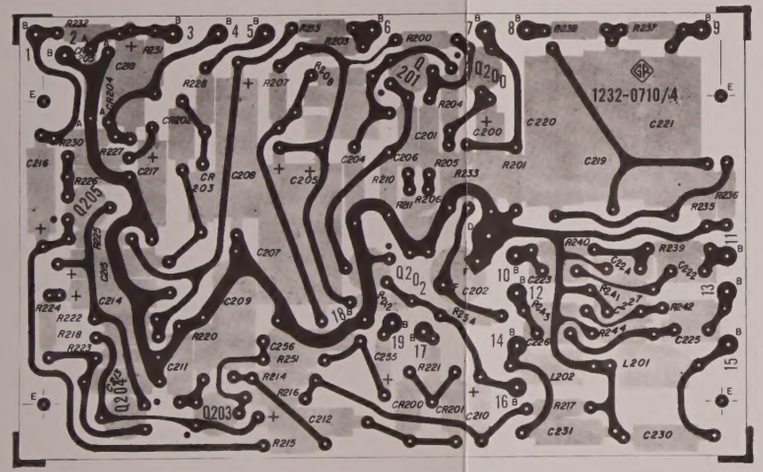


Figure 13. Etched Board Layout of the Type 1232-A Tuned Amplifier and Null Detector, P/N's 1232-2700 and 1232-2710.



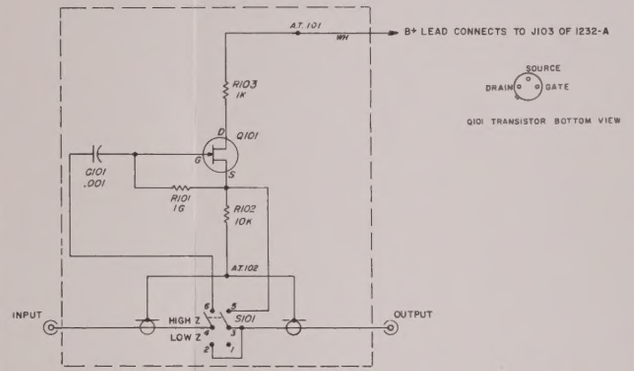


Figure 14. Schematic diagram and etched board layout of the Type 1232-P2 Preamplifier. The etched board part number is 1232-2730.

GenRad

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Printed in U.S.A. 8/88

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